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HOW SEEDS GROW

by

GWEN CROSS

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BOOK TWO

HOW SEEDS GROW

by
GWEN CROSS

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First published 1949
Sixth impression 1960

[illegible]
Date 28.7.05
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PRINTED IN GREAT BRITAIN
BY WESTERN PRINTING SERVICES LTD., BRISTOL

NOTE ON THE USE OF THE BOOK

Each chapter is divided into sections. Each of these sections will often need two or more lessons. Each section has three parts:

1. The Lesson.
2. Things to do.
3. Questions.

The main point of this book is the practical work in the garden and class room. Emphasis should be laid on:

1. Careful observation.
2. Clear, big, tidy records and drawings in the class room and books.

The drawings are diagrams. They should be drawn on the blackboard, piece by piece, slowly, while the class copies, piece by piece. The names should be written clearly, straight, and one under the other. Full directions should be given as to the size and spacing of diagrams, etc.

The book may be taken as it stands by any class whose English is sufficient.

The course can also be taken with a junior class which does not know much English yet, but can read and write in some language, and is beginning to "awake," i.e. at the end of the first year or in the second year at school. At this stage the English reading of the lessons and the answering of the questions in English are omitted. The lessons and questions can be used as a Reader and for revision later if desired.

CHAPTER I

THE PEANUT SEEDLING

SECTION ONE

BEFORE THE LESSON

Collect two glass jars with very wide mouths, blotting paper, good peanut seeds (ground nuts), and a tin of water. Put ten seeds in water for four hours before the lesson.

LESSON

When we plant seeds in the garden, after a little time we see the shoot grow up into the air. But we cannot see the root grow because it is in the soil. In the school house we can plant seeds in a glass and see how the roots grow.

If we put water at the bottom of a glass jar and then fold a piece of blotting paper like a pipe to fit in the jar, the water will go up in the paper, and the paper will be wet. If we soak seeds in water and then put them between the sides of the glass jar and the wet blotting paper, the seeds will grow. We shall see the root and the shoot between the glass and the paper.

THINGS TO DO

1. In the lesson, take one glass jar. Put water at the bottom. Put the blotting paper like a pipe in the jar. Put five soaked peanut seeds round the sides of the jar, between jar and paper. Put three seeds with the pointed end down, and two seeds with the pointed end sideways. Write down the date. Call this jar A. Put the jar in the dark. Do not let ants get into the jar. Watch the seeds. Do not let the paper get dry.
2. Plant the other five soaked peanut seeds out in the garden. Plant them upright with the pointed end down, and two inches deep in the soil.
3. Put ready the other jar with blotting paper. Do not plant seeds in it yet. After three days soak ten more seeds in water. Plant five in this jar, three upright and two sideways, and plant five in the garden as before. Write down the date. Call this jar B.
4. Write in your book the heading:

How the peanut grows

and the date when you planted the seeds.

NOTE

If you have no blotting paper, take any other paper that will drink up water, like absorbent newspaper. If you have no glass jar you can grow the seeds on a piece of wet calico or wet grass on the lid of a tin or on a plate.

QUESTIONS

1. What three things do you need if you grow seeds in the school house, and you want to see how the roots grow?

SECTION TWO

BEFORE THE LESSON

Look at the growing seeds (seedlings). Choose two seedlings for the class to draw, the first with a very little root, the second with a root one to two inches long. Keep the jars in the dark.

LESSON

The skin of the peanut seed breaks at the end near the scar. A little white root appears, and grows down. If the seed is not planted with the pointed end down, the little root will turn to grow down. The root always grows first.

Very near the end of the root, many little white hairs grow. They do not grow over the end of the root, but round and near it. They are called "root hairs." They take in water from the soil. If the root hairs of a plant are broken, the plant will die, because it will not be able to drink water. The root hairs only grow near the end of the root.

The root has a hard pointed end, called the root cap. This cap protects the root as it digs down into the soil. The end of the root moves in the soil like a screw, and this helps it to make its way down.

A young plant that grows from a seed is called a seedling.

THINGS TO DO

1. Find in your drawing-book the page: "How the peanut grows."
2. From jar B draw a growing peanut with a very little root (Fig. 1). Name the seed and the root.

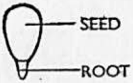

FIG. 1. THE ROOT GROWS

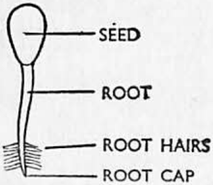

FIG. 2. THE ROOT HAIRS GROW

3. From jar A draw a seedling with a root one to two inches long (Fig. 2). Name the seed, the root, the root hairs, the root cap. Under the drawing write: *The root hairs take in water.*

Note: Do not draw the jar, or the paper.

QUESTIONS

1. What part of a plant grows first?
2. If you plant a seed so that the root points up, what will the root do when it grows?
3. Where do root hairs grow?
4. What work do the root hairs do?
5. Why does a plant die if the root breaks?
6. What protects the end of a root?
7. How does a root move in the soil?

SECTION THREE

BEFORE THE LESSON

During the week take care of the seedlings in the two jars. There should be half an inch of water at the bottom of the jars, so that the paper is always wet. Watch the two seedlings drawn in the last lesson.

LESSON

As the first root grows down, side roots grow out from it like branches. They grow long, but not as long or as fat as the first root. At the end of each side root, root hairs appear. Each has a little root cap to protect the end.

A root does three things for a plant:

(*a*) The root holds the plant in the ground.

The side roots grow out on each side of the plant into the soil, and help the plant to stand firm in a wind.

(*b*) All the root hairs take in water.

(*c*) They also take in food in the water in the soil.

THINGS TO DO

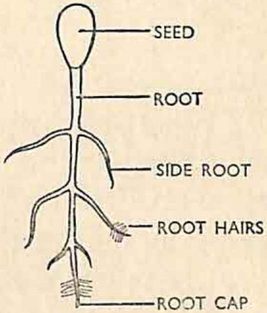

FIG. 3. THE SIDE ROOTS GROW

1. Go to the garden and see if the peanuts have come up yet above the soil.
2. Draw the peanut seedling with side roots (Fig. 3). Name the seed, first root, side roots, root hairs, root caps.
3. Take out a seedling with many side roots from jar A. Look at the side roots. Do they grow in three or in four upright lines down the root? Do they grow in opposite pairs or alternately?

QUESTIONS

1. What three things does a root do for a plant?
2. (*a*) In what way are the side roots like the first root?

   (*b*) In what way are the side roots not like the first root?

SECTION FOUR

BEFORE THE LESSON

As soon as the shoot begins to appear, put the jars into the light. Keep the paper in the jars wet as before.

LESSON

The part of the plant between the root and the seed leaves gets long and fat and pushes the seed leaves up. The seed leaves in the seed press on the seed skin, and this breaks and falls off. The two seed leaves open, and the little shoot grows from between them. It pushes up in the soil with the stem bent over to protect the young leaves at the growing end. A shoot always grows up. When the peanut grows in a glass in the light, these two seed leaves turn green. But when it is planted two inches deep in the soil, the seed leaves do not reach the air. They live in the soil, and only the shoot appears above the soil.

The work of the stem is to take branches, leaves, and presently flowers, up into the air and the sunshine. The sun helps the leaves to make food from the air.

The root is now very long and will have come to the bottom of the jar. There are many root hairs on the side roots. Some of the side roots are long and have branches.

There is no food for the seedling in the water in the jar. But the seedling grows well, because the seed leaves store the food and this food feeds it. The seedling will grow for some weeks in the jar if there is always enough water for it. Presently when all the food in the seed leaves is finished, the seedling in the jar will die. If we plant the seedlings in the garden while they are strong, they will get big and have flowers and fruit.

THINGS TO DO

1. Look at a seedling in a jar.

Find:

(*a*) first root
side roots
root hairs.

(*b*) 2 seed leaves. Broken skin of seed. Fat part under the seed leaves.

(*c*) stem
leaves.

2. Draw this seedling (Fig. 4). Name all these parts. If there are many roots do not draw them all. Make a diagram (map), not a picture, of the seedling.

3. Look at the peanuts in the garden. The shoot should now be in the air. Dig up one plant very carefully. Wash the root in water to take away all

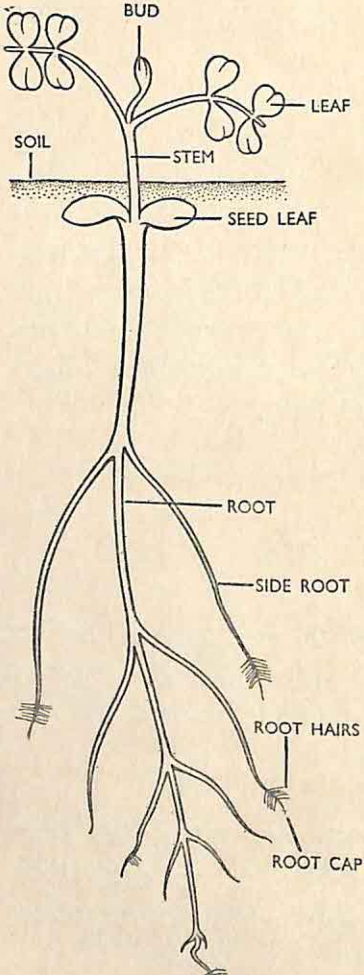

FIG. 4. PEANUT SEEDLING

the soil. Find all the parts in this seedling that you found in the first question.

4. Keep the seedlings in the jars with water for another week. Then plant them out in the garden.

QUESTIONS

1. Where does the shoot grow from?

2. How does the shoot grow?

3. Do the seed leaves come above the soil?

4. Name the parts of a shoot.

5. Why does a seedling grow well in water only?

6. Why would the seedling not grow into a big plant in the glass jar?

7. How are the leaves and growing end of the stem protected as the shoot pushes up in the soil?

CHAPTER II

THE COW PEA SEEDLING

SECTIONS ONE, TWO, THREE

At the beginning the cow pea root grows in the same way as the peanut root. Follow Chapter I, Sections One, Two and Three, for these Lessons, Things to do and Questions.

SECTION FOUR

BEFORE THE LESSON

As soon as the shoot begins to appear, put the jars into the light. Keep the paper in the jars wet as before.

LESSON

The part of the plant between the root and the seed leaves gets long and pushes the seed leaves still in the seed skin up into the air, above the glass or the soil. The shoot is protected as it pushes up in the soil by the two seed leaves, and by the tough skin of the seed (Figs. 5 and 6).

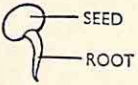

FIG. 5.
THE ROOT
GROWS

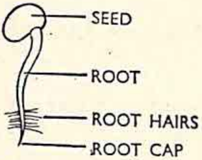

FIG. 6. THE ROOT
HAIRS GROW

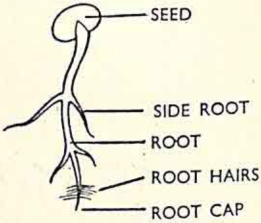

FIG. 7. THE SIDE
ROOTS GROW

The first two leaves grow opposite each other and have undivided blades (simple leaves). All the other leaves on the plant have blades divided into three parts. Leaves like these are called compound leaves.

The food in the seed leaves still helps to feed the seedling. Presently, when the seedling has finished all this store of food, the two dry seed leaves fall off.

The first root grows very long and has many side roots growing from it (Fig. 7). These do not get as long or as fat as the first root. When the first root is the longest of a plant, the root is called a tap root.

THINGS TO DO

1. Read and learn again pages 10 and 11.
2. Look at the seedlings in the jar when the seed leaves are in the air.

THE COW PEA SEEDLING

Find seedlings with:

(*a*) Skin over seed leaves breaking (Fig. 8*a*).

(*b*) Skin fallen off and seed leaves bare (Fig. 8*b*).

(*c*) Seed leaves open and shoot between them (Fig. 9).

(*d*) Seedling with first two green leaves (simple) (Fig. 10).

(*e*) Seedling with a 3-part compound leaf (Fig. 11).

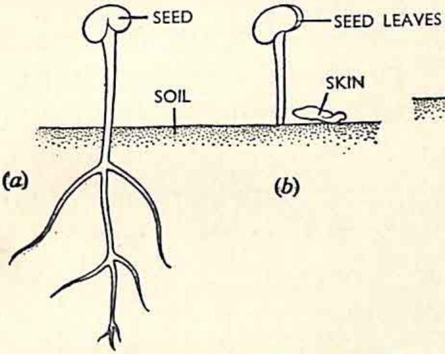

FIG. 8. THE SEED GROWS ABOVE THE SOIL

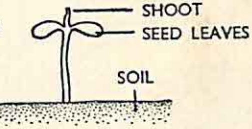

FIG. 9. THE SEED LEAVES OPEN

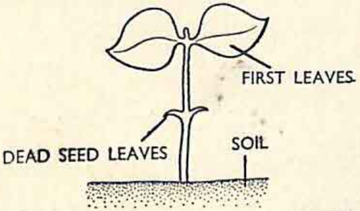

FIG. 10. THE FIRST LEAVES OPEN

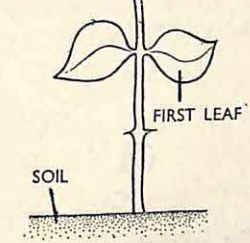

FIG. 11. THE COMPOUND LEAVES OPEN

3. Draw these five seedlings. In (*a*) name: tap root, side roots, root hairs, root cap.

In (*b*), (*c*), (*d*), (*e*) do not draw the root. Name: seed leaves, seed skin, shoot, simple leaves, compound leaves.

4. Find seedlings in the garden like these five seedlings.

5. Dig up one seedling from the soil. Wash away the soil. Look at the long tap root. Find side roots and root hairs.

6. Dig up an older cow pea plant with young fruits on it. Wash away the soil. Look for little round balls on the root. These balls help the plant to make food. Look for these round balls on the roots of peanut plants.

7. Watch other seeds where you plant them in the garden: pumpkins, water melons, cucumbers, Lima beans, calopogonium, crotalaria, etc.

Write at the top of a page in your book:

What seed leaves do when seeds grow.

Divide the page into two columns (roads).

(*a*) At the top of one column write:

Seed leaves live in the soil.

(*b*) At the top of the other column write:

Seed leaves come up into the air.

In which column—(*a*) or (*b*)—will you now write Peanut and Cow Pea?

As each seedling in the garden grows up, look for the seed leaves in the air or the soil, then write the name of that plant in column (*a*) or (*b*).

QUESTIONS

1. Name two seedlings whose seed leaves come above the soil.
2. Name two seedlings whose seed leaves do not come above the soil.
3. Copy a sentence about the first two green leaves of the cow pea; learn the sentence.
4. What are all the other leaves on the plant like?
5. What is a tap root?
6. How is the cow pea shoot protected as it pushes up through the soil?

CHAPTER III

THE MAIZE SEEDLING

SECTION ONE

Read pages 4 and 5, and then plant maize grains in place of peanut seeds.

SECTION TWO

BEFORE THE LESSON

Choose a grain with only one root a half to one inch long, for the class to draw.

LESSON

The first root of the maize grain grows out from the middle of the shield-like mark above the stalk. It grows down and root hairs appear near the end, behind the root cap.

THINGS TO DO

1. Draw the maize root with one root a half to one inch long (Fig. 12). Name: the grain, first root, root cap, broken skin.

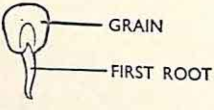

FIG. 12. THE ROOT GROWS

2. Take a lid of a tin. Put just a little water in it and then a little piece of wet calico or paper. On the wet calico put six grains of soaked paddy (rice grains not husked or polished). Watch the paddy for the first roots.

Do not let the calico get dry.

Little grains or seeds grow more easily like this than in a glass.

QUESTIONS

Answer the questions on page 12 about the maize seedling.

SECTION THREE

BEFORE THE LESSON

Look at the jars of maize seedlings, and choose a seedling with new little roots growing out *from the grain* for the class to draw.

LESSON

When the first root is 1–2 inches long, new roots appear (Fig. 13). They come from the shield-like mark where the first root came out. These roots are not side roots of the first root. They grow from the bottom of the stem of the baby plant. They are called second roots. These roots quickly grow as long as the first root. When the maize in the garden has fruited and we cut it down and dig it into the soil, we can look at the root of the plant. We see many roots all equal. No one root is longer or bigger than the others. We can see many roots growing from the bottom of the stem. There is no tap root. These roots help the maize plant to stand firm in a wind.

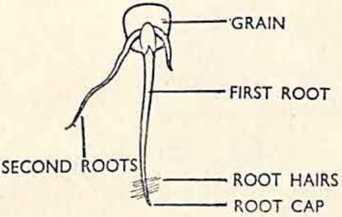

FIG. 13. THE SECOND ROOTS GROW

THINGS TO DO

1. Look at all the seedlings in the glasses. Find the second roots in seedlings when they are:

(*a*) short,
(*b*) 2–3 inches long,
(*c*) as long as the first root.

2. (*a*) Draw a seedling with short second roots (Fig. 13).

(*b*) Draw a seedling with second roots 1–2 inches long (Fig. 14).

Name: first root, second roots, root hairs, root cap.

3. Look at the rice planted on the wet calico. Find the first root, second roots and root hairs.

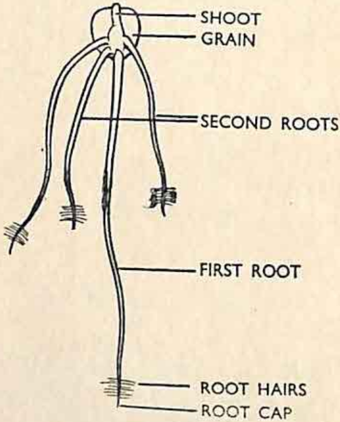

FIG. 14. MORE SECOND ROOTS GROW

QUESTIONS

1. Where do the second roots grow from?
2. Has the maize seedling a tap root?
3. What are the things a root does? (Read pages 8 and 9.)

THE MAIZE SEEDLING

SECTION FOUR

BEFORE THE LESSON

Look in the glass jars and in the garden for maize seedlings with the shoot beginning to grow up into the air.

LESSON

The skin of the grain breaks in the middle of the shield-like mark and the shoot appears. It is straight and pointed. The end of the shoot is not folded over as it is in the cow pea. The leaves are tightly folded round the stem. This makes a "spear-head" that can push up easily in the soil, and so protect the growing end of the stem. Then the leaves open. Each leaf is long and narrow like a blade of grass. The leaves grow alternately up the stem.

The one thin seed leaf in the grain does not come out of the grain. It passes the yellow and white food stored in the grain to the growing seedling. It does not store food to feed the seedling. The baby seedling gets its food from the store in the grain.

More second roots grow from the bottom of the stem. They grow down into the soil and grow side roots and root hairs.

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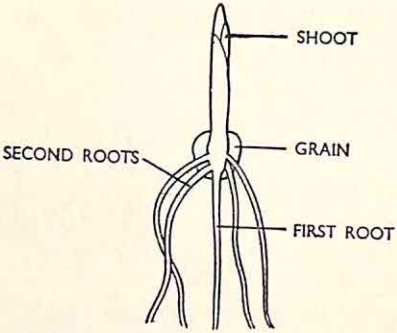

FIG. 15. THE SHOOT GROWS

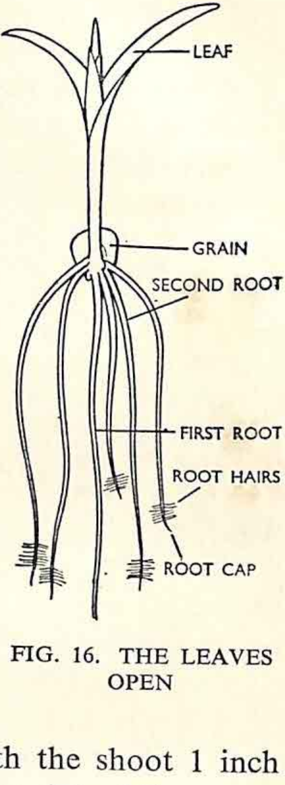

FIG. 16. THE LEAVES OPEN

THINGS TO DO

1. Draw a maize seedling with the shoot 1 inch high and the leaves not yet open (Fig. 15).
2. Draw a maize seedling with the shoot 2–3 inches high and the leaves open (Fig. 16). Name: leaf, shoot, first root, second root, root hairs.
3. Look at the rice growing on the wet calico. Find all the parts you have named in the last question.
4. Find in your book the page you divided into two

columns (see page 16). In which column—(*a*) or (*b*)—will you now write Maize and Rice?

5. Look at the maize in the garden. Dig up one seedling that has leaves open. Wash the soil from the roots. Find all the parts of the plant named in the second question.

QUESTIONS

1. How do the leaves of the maize grow?
2. What work does the one seed leaf do?
3. Where does the baby seedling get its food from?
4. What are the maize leaves like?
5. How is the growing end of the stem protected as it pushes up in the soil?

Note. The shoot may appear when the second roots are still short; that is, at the stage described in Section Three.

CHAPTER IV

WHAT PLANTS NEED TO GROW WELL

SECTION ONE

BEFORE THE LESSON

Collect pictures of very cold countries and of very dry countries. These pictures show that there are few plants and animals in these places.

LESSON

We know that if a man has no *air* he will die. A new-born baby must fill its lungs with air as soon as it is born. If it does not do so, it will die. Air is the one thing every little animal can take for itself when it is born. It must take the air without the help of father or mother. If a new-born baby does not breathe, we must hit it on the back. The baby will cry, and so take air into its lungs and begin to breathe. A man cannot live more than three minutes without air.

A man must also have *water* and *food.* When he is little, we must give him these things. When he is big, he must find them for himself. A man cannot live more than three days without water or three weeks without food.

If a man is to be strong and healthy, he also needs some *heat.* In very cold places a man will die.

A man also needs *light.* If he lives for a long time in a dark place, he will be weak and ill. In some countries doctors put some sick people every day in the sunshine. Then after some months these people often get well and strong again. Light is like a medicine and helps to make strong bodies.

For life man needs air, water, food, light and heat.

When we think about animals and plants we know that they also need some of all these things. Perhaps we know from our own village that the plants in our gardens die if there is not enough rain. Perhaps we have seen some sweet potatoes or maize growing under a tree where there was not enough light, and have seen that these plants were not strong, and did not make good food. Perhaps we have visited a place where the soil was tired and hungry and we have seen that the crops in that place were not good.

Perhaps we have read in books about these things. Many books tell us about times of famine in countries like India. In these countries sheep and cattle and other animals often die because they are without water and food. In books also we often see pictures of other countries. In these pictures we see that in very cold countries, or in very hot, dry countries, only very few animals live. In the next lesson we shall plant seeds in the school room, and put them in different places to see how they grow.

THINGS TO DO

1. This week look at plants that grow in shady places. How are they different in size and colour of leaves, stem and fruits from other plants in the sunlight?

2. Put a box or piece of wood or tin on some grass. Take it away after a week. What is the grass like now?

3. Look at plants with big leaves like pumpkins at midday in the sunshine, and at any time after rain. What does the hot sun do to the leaves? How does the rain help?

QUESTIONS

1. Fill the gaps in the following sentence with one of these words: *food*, *air*, *water*. A man cannot live more than
   3 minutes without ...... 3 days without ....
   3 weeks without ....
2. What can every baby take for itself when it is born?
3. If a new-born baby does not breathe, what can you do at once to make it breathe?
4. What five things do men and animals need in order to grow?
5. Write the word meaning the opposite of: *wet*, *cold*, *hot*, *dry*.

SECTION TWO

BEFORE THE LESSON

Collect five tins and one wide jar with a lid. Leave one tin empty but put soil in all the others. Get about 30 cow pea seeds, or any other seeds that grow quickly. Do not soak the seeds in water. Cut six pieces of paper or bamboo for names.

LESSON

If we plant seeds in different tins, and put these tins in different places, so that the seeds in each tin are without one of the things which man needs for life, we shall see which seeds will grow.

First number the six labels and write on them like this:

1. No air.
2. No water.
3. No food.
4. No light.
5. Very hot.
6. All 5 things.

Then we put seeds into the jar and tins in this way:

Jar 1—No Air. Put soil up to the neck of the jar and then plant the seeds. We must not let the soil get dry. Water it and then put on the lid. These seeds have water, food, light and some heat.

Tin 2—No Water. Plant 5 seeds in dry soil, and do not water them. Leave the tin in the light and air. These seeds have air, food, light and some heat.

Tin 3—No Food. Do not put in any soil. Soak 5 seeds in water, and then take away the skin and seed leaves. Only the little root and shoot of each seed is left. Put the seeds in the tin in the air and light. These seeds have air, water, light and some heat.

Tin 4—No Light. Plant 5 seeds in soil and water them. Put the tin somewhere where it is always dark. These seeds have air, food, water, and some heat.

Tin 5—Very hot. Plant 5 seeds in the soil and water them. Then put the tin in a place near the fire. These seeds have air, water, food, heat, light, but they are very hot.

Tin 6. Plant seeds in the soil and water them. These seeds have air, water, food, light and some heat.

Leave all the five tins and the jar for a week.

THINGS TO DO

1. Look at these five tins and the jar every day. See that, except Tin 2, they have water and that the ants do not eat them.
2. Plant a few shoots:
    - (*a*) under a big tree,
    - (*b*) in good soil in the light,
    - (*c*) in wet soil near a swamp,
    - (*d*) in sandy soil near the sea, if you can.

Look at the plants in these places every few weeks. Write down about how they grow.

3. In your book draw diagrams of the five tins and jar. Do not draw the seeds yet.

QUESTIONS

1. Can seeds grow without air?
2. Can seeds grow without food?

SECTION THREE

BEFORE THE LESSON

Collect the five tins and the jar.

LESSON

We look now at the seeds planted last lesson.

In *Jar 1—No air* (Fig. 17), we see that the seeds have not grown.

In *Tin 2—No water* (Fig. 18), the seeds have also not grown at all.

In *Tin 3—No food* (Fig. 19), the baby plants (that had no food leaves and no soil) are all dead.

In *Tin 4—No light* (Fig. 20), the seeds have grown. But the stems are yellow and long and weak. We will keep these seedlings and put them back in the dark.

In *Tin 5—Very hot* (Fig. 21), the seeds have not grown at all.

In *Tin 6* (Fig. 22), the seedlings are strong and green, they have grown well.

We see that only those seeds grow well that have air, water, food, light and some heat. Without air or water or food, or if they are very hot, they will not grow at all. Without light the seeds grow but the seedlings are weak. If they stay in the dark the stems get very long and they are white, and the leaves are small and yellow. If the seedlings are left in the dark they will die. If they have not been

HOW SEEDS GROW

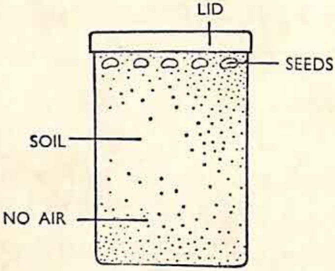

FIG. 17

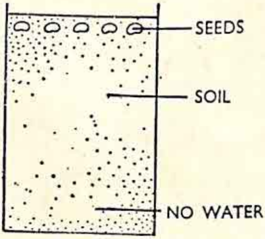

FIG. 18

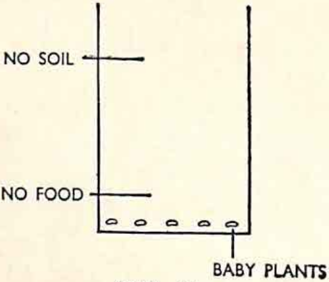

FIG. 19

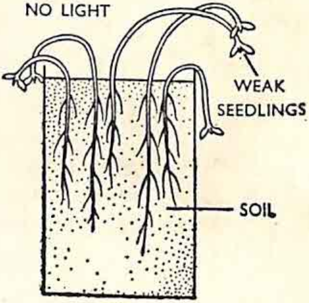

FIG. 20

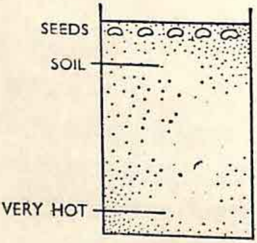

FIG. 21

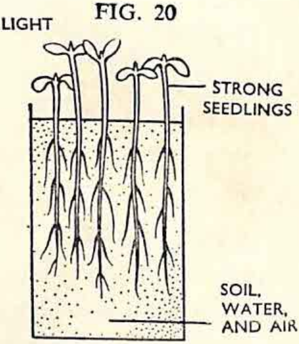

FIG. 22

PLANTS NEED AIR, WATER, FOOD, LIGHT AND SOME HEAT TO GROW WELL long in the dark and then we put them in the light, the stem will grow strong and green and the leaves also will be big and green.

THINGS TO DO

1. Put Tin 4 back in the dark and watch how the seedlings grow.
2. In the diagrams made in Section Two, now draw the seeds and seedlings in each jar or tin as they are at the end of the week.

QUESTIONS

1. Name two things without which a plant will not grow at all.
2. If a seedling grows in the dark:
   (*a*) What is the stem like?
   (*b*) What are the leaves like?

You may find these words difficult. When you meet them in this book try to think out for yourself what they mean. If you think you have found the meaning, make sure that you are right. To do so look the word up in the New Method Dictionary. If you still cannot make sense of the word, ask your teacher for help.

Chapter One

SECTION ONE

blotting paper
glass
shoot
bottom
while
between
pointed
fold
soak
absorbent

SECTION TWO

end
seedling
cap
hairs
near
always
young
screw
break
appear
turn
protect
move

SECTION THREE

branch
firm
side

SECTION FOUR

enough
above
reach
press
turn

Chapter Two

opposite
still
simple
compound
push
tap root
divide
undivided

Chapter Three

SECTION ONE

second
long-er
big-ger
than
equal

SECTION TWO

straight
narrow
vertically
alternate
folded
pointed
blade
pass

Chapter Four

SECTION ONE

country
animal
sunshine
famine
colour
air
lungs
head
body
size
born
itself
himself
without
healthy
weak
perhaps
enough
tired
hungry
shady
need
visit

SECTION TWO

swamp
empty
life
soak
leave

Translate:

(*a*) The plant is *weak.*
(*b*) I put the plant in the dark for a *week.*

TROPICAL LIBRARY

Garden Series

1 HOW SEEDS ARE MADE
2 HOW SEEDS GROW
3 THE ROOT
4 THE LEAF
5 THE FLOWER
6 THE FRUIT

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